

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



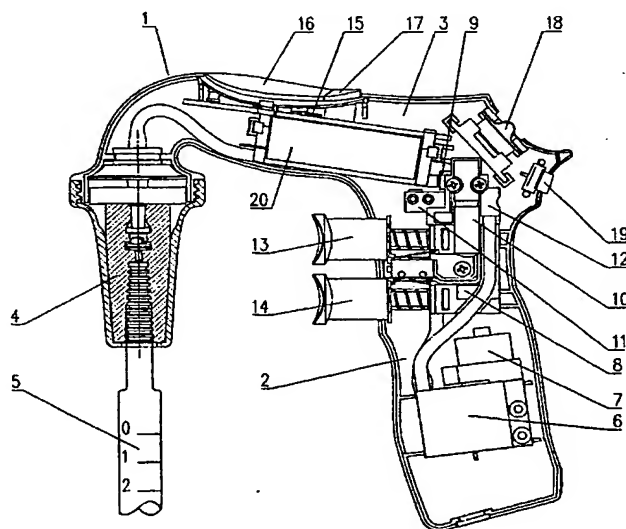
(43) International Publication Date  
29 July 2004 (29.07.2004)

PCT

(10) International Publication Number  
**WO 2004/062805 A1**

- (51) International Patent Classification<sup>7</sup>: **B01L 3/02**, G01N 1/14
- (21) International Application Number: PCT/PL2003/000035
- (22) International Filing Date: 8 April 2003 (08.04.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: P.358260 14 January 2003 (14.01.2003) PL
- (71) Applicant (for all designated States except US): **PZ HTL SPÓŁKA AKCYJNA** [PL/PL]; ul. Daniszewska 4, PL-03-230 Warszawa (PL).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **CZERNECKI, Andrzej** [PL/PL]; ul. Zakopianska 10, PL-03-934 Warszawa (PL). **WYSZOGRODZKI, Wojciech** [PL/PL]; ul. Ostrońska 56 X, PL-03-289 Warszawa (PL). **JANKOWSKI, Andrzej** [PL/PL]; ul. Sucharskiego 4 m. 74, PL-01-390 Warszawa (PL). **URBAN, Piotr** [PL/PL]; ul. Pirenejska 1 m. 62, PL-01-493 Warszawa (PL).
- (74) Agents: **KOWAL, Elzbieta** et al.; Polservice Sp. z o.o., P.O. Box 335, PL-00-950 Warszawa (PL).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**  
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF DISPENSING LIQUID IN A PIPETTING DEVICE AND THE PIPETTING DEVICE



(57) Abstract: In the method of dispensing liquid according to the invention, when liquid is aspirated by the pump to the pipette, the required size of dose of the liquid is dispensed from the pipette in proportion to the atmospheric air fed thereto through a valve or a set of valves connected to the pipette, whereas the amount of supplied atmospheric air is processor programmed by the determination of time and/or flow rate and/or damping of the supply of atmospheric air into the pipette. Pipetting device according to the invention comprises a housing with a handle (3) for mounting the pipette (4), whereas in the housing, an air pump (6) is located, connected to the pipette (5), and a processor (15) to control the operation of the device. The pipetting device comprises also a set of valves (10) for processor (15) controlled atmospheric air flow during dispensing liquid, whereas the set of valves (10) is connected to the pipette (5).

BEST AVAILABLE COPY

**THIS PAGE BLANK (USP 10)**

2/PRTS

10/540213

JC17 Rec'd PCT/PTO 20 JUN 2005

## METHOD OF DISPENSING LIQUID IN A PIPETTING DEVICE AND THE PIPETTING DEVICE

### (Background of the Invention)

10

#### 1. Field of the Invention

This invention relates to the method of dispensing liquid in a pipetting device and the pipetting device.

15

#### 2. Description of the Related Art

The German patent publication No. 3818704 discloses a pipetting device comprising a housing with a handle and a holder to mount a pipette. The device moreover comprises a suction assembly for aspirating liquid into the pipette, and an assembly for dispensing the aspirated liquid from the pipette such that the negative pressure from the device is released to atmosphere.

20

The U.S. patent publication No. 5509318 discloses an automatic device for filling a pipette, assigned to operate with a standard glass vessel or a plastic pipette, to aspirate and dispense a determined quantity of liquid, whereas the device comprises a housing with a handle and a holder to mount a pipette, electric motor, a peristaltic pump comprising a squeezable hose fixed in the housing and driven by the motor to effect the flow of liquid, tubing to connect the pump with the pipette holder, and a control system to control the motor and the pump.

25

Further, the U.S. patent No. 6090348 discloses a method of controlling an electronic device for filling a pipette in the manual mode of operation so as to simulate

manual control of this device. The pipette filling device has the first operation button to aspirate liquid, and the second operation button to dose the liquid from the pipette mounted to this device, and a computerised system to control the manual operation mode of the device. In the method according to this invention, first the device for filling a  
5 pipette starts to operate, the computer control system is activated in manual operation mode, the pipette is immersed in liquid, the first button is depressed so the pipette filling device sucks the liquid in, and the pipette is removed from the liquid. Next the second button is depressed to dose the aspirated liquid by the pipette filling device, whereas the aspiration and dosing ratios are related to the value of forces applied to the first and the  
10 second button, and the computer system sets the pipette filling device in manual operation mode to control the rate of aspiration and dispensing so as to simulate manual pipette filling devices.

### **(Summary of the Invention)**

15

According to the present invention, the method of dispensing liquid in a pipetting device comprises a housing with a holder to mount a pipette, whereas an air pump connected to the pipette, and a processor controlling the device operation is disposed in the housing, wherein after aspiration by the pump of liquid into the pipette, the required  
20 size of the liquid dose is dispensed from the pipette in proportion to the amount of atmospheric air supplied thereto through a valve or a set of valves connected to the pipette, where the amount of the supplied atmospheric air is programmed in the processor by determination of time and/or flow rate and/or damping of the supply of atmospheric air to the pipette.

25

Preferably the amount of air supplied to the pipette is determined basing on stored in the processor memory air flow function related to the type of liquid and/or pipette.

Preferably the amount of air supplied to the pipette is determined basing on stored in the processor memory standard air flow tables related to the type of liquid and/or pipette.

Preferably data concerning air flow are input to the processor memory from an  
5 external appliance.

Preferably the external appliance communicates with the pipetting device by wire or in wireless manner.

Preferably a programmable controller or a computer is applied as the external appliance.

10 According to the present invention, the pipetting device comprises a housing with a pipette mounting holder, whereas an air pump connected to the pipette is disposed in the housing, and it includes at least one valve for controlled atmospheric air flow during liquid dispensing, whereas this valve is connected to the pipette.

According to a variety of the present invention, the pipetting device comprises a  
15 housing with a pipette mounting holder, whereas an air pump connected to the pipette, and a processor controlling the operation of the device are disposed in the housing, and it includes a set of valves for processor controlled atmospheric air flow during liquid dispensing, whereas this set of valves is connected to the pipette.

Preferably the valve set output is connected between the air flow distributor  
20 connected to the air pump and controlled by the liquid aspirating button and the liquid dispensing button and the pipette.

Preferably it includes at least one air flow damper in the path of atmospheric air flow with the valve.

Preferably it includes a set of air flow dampers connected to the inlet of the set of  
25 valves.

Preferably a programmed dispensing button is connected to the processor with the display and function selection and function confirmation buttons.

Preferably the set of valves is controlled by the processor.

Preferably the air flow damper and/or the set of air flow dampers is controlled by the processor.

Preferably the processor is controlled from an external appliance.

Preferably it includes an air flow three-way pipe which is connected between the air flow distributing valve, the pipette and the outlet from the set of valves.

Preferably it includes a manifold which is connected between the output from the set of valves and the air flow three-way pipe.

Preferably the function of programmed dispensing button is after programmed switching by the processor taken over by the liquid aspiration button.

Preferably the processor includes stored in its memory air flow functions or standard air flow tables which take into account the type of used liquid and/or pipette.

The solution according to the invention ensures high accuracy of liquid dispensing, especially programmed dispensing of the pre-set liquid doses from the pipette of the pipetting device.

#### **(Brief description of the drawings)**

The accompanying drawings, which are incorporated in, and form a part of the specification, illustrate embodiments of the present invention and, together with the description, serve to explain the principles of the invention. In the drawings:

Fig. 1 shows the longitudinal section of pipetting device according to the invention;

Fig. 2 shows the diagram of functional links of elements of the pipetting device.

#### **(Detailed description of the Invention)**

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings.

The pipetting device shown in the longitudinal section in the Fig. 1 has a housing (1) with a handle (2) and a sleeve (3), whereas the sleeve (3) is tipped with the holder (4) assigned to mount the pipette (5). In the handle (2) of the housing (1) an air pump (6) driven by a motor (7), an air flow distributing valve (8), an air flow three-way pipe (9),  
5 an assembly of valves (10), a set of air flow dampers (11), and a manifold (12) as well as a liquid aspiration button (13) and a liquid dispensing button (14) are disposed. In turn, in the sleeve (3) of the housing (1) of the device a processor (15), a display (16), function selection and function confirmation buttons (17) and (18), a programmed dosing button (19) and a rechargeable battery (20) are disposed.

10 Functional links of the elements of the pipetting device are illustrated in the Fig. 2. The air pump (6) driven by the motor (7) powered from the rechargeable battery (20) is connected with an air tubing from the air flow distributing valve (8) controlled by the liquid aspiration button (13) and the liquid dispensing button (14). Next the outlet of the air flow distributing valve (8) is further connected with the air tubing through the air  
15 flow three-way pipe (9) to the holder (4) and the pipette (5) mounted therein. The described assembly is a known pipetting device.

In the pipetting device according to the preferred embodiment of the invention, an assembly of valves (10) is applied for controlled flow of atmospheric air during dispensing liquid from the pipette (5). The outlet of the assembly of valves (10) is  
20 connected by the means of an air tubing to the air flow three-way pipe (9), and further to the pipette (5) mounted to the holder (4), while the inlet to the assembly of valves (10) is at the same time the inlet of atmospheric air, whereas in the path of atmospheric air to the pipette (5) at the inlet to the assembly of valves (10) a set of air flow dampers (11) is disposed, while at the outlet from the assembly of valves (10) an atmospheric air  
25 manifold (12) is disposed.

The air pump (6), assembly of air flow valves (10), and set of air flow dampers (11) are controlled by the processor (15) which has stored in its memory air flow functions or standard air flow tables which take into account the type of used liquid and/or pipette (5). In turn, the processor (15) with the display (16) attached thereto is

controlled by the function selection and function confirmation buttons (17) and (18), the programmed dispensing button (19), as well as the liquid aspirating button (13) and the liquid dispensing button (14) from the air flow distribution valve (8). The application of the programmed dispensing button (19) in another embodiment of the pipetting device  
5 according to the invention is not necessary if its functions are taken over by the liquid aspirating button (13) after programmed switching by the processor (15), which aspirating function is restored when the programmed sequence is finished or when the liquid dispensing button (14) is pressed.

The method of dispensing liquid from the pipette by the pipetting device  
10 according to the invention is accomplished as follows. Primarily to the memory of the processor (15) data regarding the device operational procedure are input in the form of air flow functions or air flow standard tables related to the used liquid and/or applied pipette (5). The device operational procedure comprises the quantity of atmospheric air supplied to the pipette (5) which is related mainly to the time of feeding, flow rate and  
15 damping of atmospheric air supply. Operational procedure data may be entered directly to the pipetting device using its buttons, or from an external appliance. The external appliance may communicate then with the pipetting device by wire or wirelessly, especially by radio signals or in optical way, whereas preferably a programmable controller or a computer is applied as the external appliance.

20 After aspirating liquid into the pipette (5), on depressing the aspiration button (13) and by the use of the air pump (6), the programmed dosing procedure is carried out. By the function selection and function confirmation buttons (17, 18) with simultaneous examination of the data read-out from the display (16), pipette (5) data can be selected, or automatic selection is confirmed. Next operational procedures are selected, e. g.  
25 normal operation, operation to the factory pre-set programme, or operation to the user's own programme. Within the framework of operations to the factory pre-se programme or user's own programme, titration, serial dispensing of the same quantity of liquid, or serial dispensing of various quantities of liquid may be selected. Depending on the selected procedure, pipette, liquid or another parameter, the processor (15) determines



the time and/or rate of supply of atmospheric air, and the magnitude of introduced damping appropriate for the dose to be dispensed. Information regarding the pipetting device operational state are displayed on the display (16). Depressing the programmed dispensing button (19) caused the dispensing of the programmed liquid dose, whereas  
5 for the sake of ensuring safety of work, release of this button denotes discontinuation of the process of dispensing liquid. In order to return to the procedure, the remaining liquid must be blown out by depressing the dispensing button (14), and next in the programmed way the liquid must be aspirated by depressing the aspiration button (13). In order to make it impossible to flood the pipette (5), depressing of the aspiration button (13) will not  
10 result in programmed liquid aspiration unless the dispensing button (14) is depressed beforehand. Subsequent pressing and holding the programmed dispensing button (19) results during dispensing subsequent programmed volumes of liquid, whereas each time dispensing of the programmed quantity of liquid is accomplished by opening for a determined time of an appropriate valve from the set of valves (10) connected with  
15 thereto assigned air flow damper from the set of air flow dampers (11), whereas both, the set of valves (10), and the set of air flow dampers (11) are processor (15) controlled.

In another preferred embodiment of the invention the pipetting device comprising a housing (1) with a holder (4) for mounting a pipette (5), and located in the housing (1) an air pump (6) connected to the pipette (5), includes a valve for controlled flow of  
20 atmospheric air during liquid dispensing, whereas this valve is connected to the pipette (5). Moreover it includes an air flow damper in the atmospheric air flow path with such valve. In this embodiment both, the atmospheric air flow control valve for liquid dispensing, and the air flow damper may be controlled by an analogue signal or a digital signal, for example from the processor (15).

5           **We claim:**

1. The method of dispensing liquid in a pipetting device comprising a housing with a holder to mount a pipette, whereas an air pump connected to the pipette, and a  
10 processor controlling the device operation is disposed in the housing, wherein after aspiration by the pump of liquid into the pipette, the required size of the liquid dose is dispensed from the pipette in proportion to the amount of atmospheric air supplied thereto through a valve or a set of valves connected to the pipette, characterised by that  
15 the amount of the supplied atmospheric air is programmed in the processor by determination of time and/or flow rate and/or damping of the supply of atmospheric air to the pipette.

2. The method according to the claim 1 characterised by that the amount of air supplied to the pipette is determined basing on stored in the processor memory air flow function related to the type of liquid and/or pipette.

20 3. The method according to the claim 1 characterised by that the amount of air supplied to the pipette is determined basing on stored in the processor memory standard air flow tables related to the type of liquid and/or pipette.

4. The method according to the claim 2 or 3 characterised by that data concerning air flow are input to the processor memory from an external appliance.

25 5. The method according to the claim 4 characterised by that the external appliance communicates with the pipetting device by wire or in wireless manner.

6. The method according to the claim 4 characterised by that a programmable controller or a computer is applied as the external appliance.

7. The pipetting device comprising a housing with a pipette mounting holder, whereas an air pump connected to the pipette is disposed in the housing, characterised by that it includes at least one valve for controlled atmospheric air flow during liquid dispensing, whereas this valve is connected to the pipette (5).

5 8. The pipetting device comprising a housing with a pipette mounting holder, whereas an air pump connected to the pipette, and a processor controlling the operation of the device are disposed in the housing, characterised by that it includes a set of valves (10) for processor (15) controlled atmospheric air flow during liquid dispensing, whereas this set of valves (10) is connected to the pipette (5).

10 9. The device according to the claim 8 characterised by that the valve set (10) output is connected between the air flow distributor (8) connected to the air pump (6) and controlled by the liquid aspirating button (13) and the liquid dispensing button (14), and the pipette (5).

15 10. The device according to the claim 7 characterised by that it includes at least one air flow damper in the path of atmospheric air flow with the valve.

11. The device according to the claim 8 characterised by that it includes a set of air flow dampers (11) connected to the inlet of the set of valves (10).

20 12. The device according to the claim 8 characterised by that a programmed dispensing button (19) is connected to the processor (15) with the display (16) and function selection and function confirmation buttons (17, 18).

13. The device according to the claim 8 characterised by that the set of valves (10) is controlled by the processor (15).

14. The device according to the claim 10 or 11 characterised by that the air flow damper and/or the set of air flow dampers (11) is controlled by the processor (15).

25 15. The device according to the claim 13 or 14 characterised by that the processor (15) is controlled from an external appliance.

16. The device according to the claim 9 characterised by that it includes an air flow three-way pipe (9) which is connected between the air flow distributing valve (8), the pipette (5) and the outlet from the set of valves (10).

17. The device according to the claim 16 characterised by that it includes a manifold (12) which is connected between the output from the set of valves (10) and the air flow three-way pipe (9).

5 18. The device according to the claim 12 characterised by that the function of programmed dispensing button (19) is after programmed switching by the processor (15) taken over by the liquid aspiration button (13).

19. The device according to the claim 8 characterised by that the processor (15) includes stored in its memory air flow functions or standard air flow tables which take into account the type of used liquid and/or pipette.

10/540213

1/2

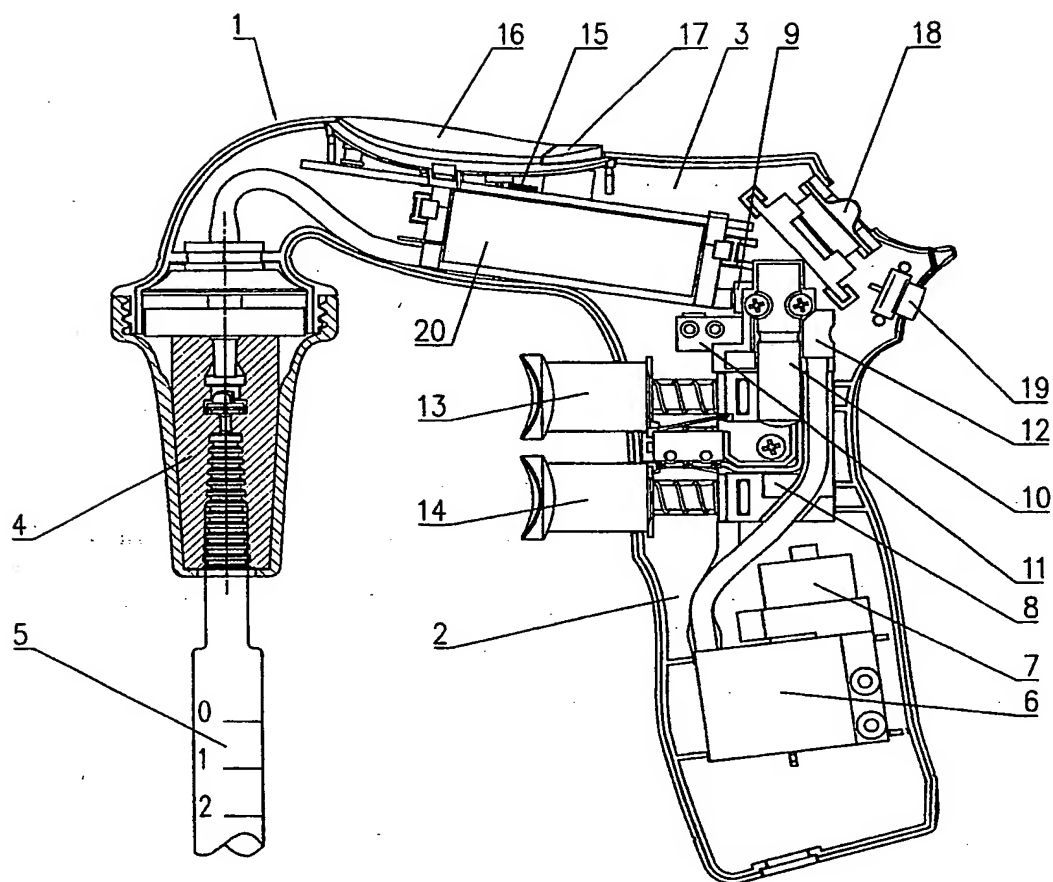


Fig. 1

JCT7 REC'd PCT/PIC 20 JUN 2005

2/2

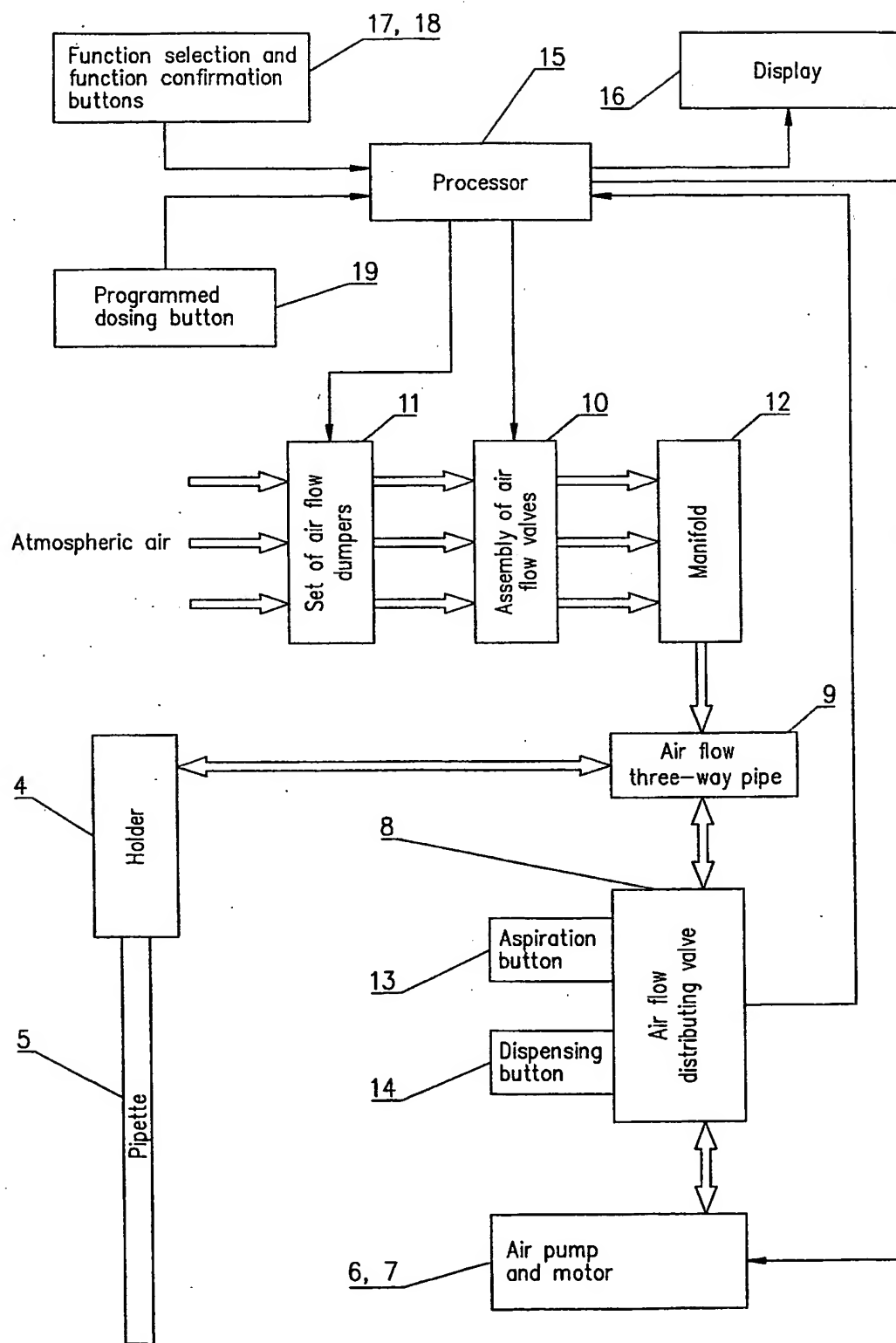


Fig. 2

JC17 Rec'd PCT/PTO 20 JUN 2005



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/PL 03/00035

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 B01L3/02 G01N1/14

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 B01L G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 214 968 A (KENNEY JAMES W) 1 June 1993 (1993-06-01) column 1, line 47 -column 2, line 19; figure 1	7
A	the whole document	1-6,8-19
A	US 5 294 405 A (KENNEY JAMES W) 15 March 1994 (1994-03-15) column 2, line 17-48; figures 1-8	1-19
A	US 5 090 255 A (KENNEY JAMES W) 25 February 1992 (1992-02-25) column 2, line 6-30; figures 1,2	1-19
A	US 3 963 061 A (KENNEY JAMES W) 15 June 1976 (1976-06-15) column 2, line 11 -column 3, line 18; figure 1	1-19
-/-		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- \*Z\* document member of the same patent family

Date of the actual completion of the international search

12 August 2003

Date of mailing of the international search report

21/08/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Skowronski, M

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/PL 03/00035

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 456 137 A (HIRSCHMANN GLASGERAETE) 13 November 1991 (1991-11-13) column 1, line 58 -column 5, line 53; figure 1 ---	1-19
A	US 5 509 318 A (GOMES FRANCIS) 23 April 1996 (1996-04-23) cited in the application the whole document ---	1-19
A	EP 0 344 792 A (HIRSCHMANN GLASGERAETE) 6 December 1989 (1989-12-06) cited in the application the whole document ---	1-19
A	EP 0 864 364 A (BECTON DICKINSON CO) 16 September 1998 (1998-09-16) cited in the application the whole document -----	1-19

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/PL 03/00035

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5214968	A	01-06-1993	NONE	
US 5294405	A	15-03-1994	DE 69320951 D1 DE 69320951 T2 EP 0635125 A1 JP 8503409 T WO 9321509 A1	15-10-1998 28-01-1999 25-01-1995 16-04-1996 28-10-1993
US 5090255	A	25-02-1992	NONE	
US 3963061	A	15-06-1976	NONE	
EP 0456137	A	13-11-1991	DE 4014588 A1 EP 0456137 A2	14-11-1991 13-11-1991
US 5509318	A	23-04-1996	CA 2117929 A1 DE 4436595 A1 GB 2282883 A , B	14-04-1995 20-04-1995 19-04-1995
EP 0344792	A	06-12-1989	DE 3818704 A1 AT 83174 T DE 58902939 D1 EP 0344792 A2 JP 2110323 A	07-12-1989 15-12-1992 21-01-1993 06-12-1989 23-04-1990
EP 0864364	A	16-09-1998	US 6090348 A EP 0864364 A2 JP 10311781 A	18-07-2000 16-09-1998 24-11-1998

**THIS PAGE BLANK (USF10)**

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☒ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**

**THIS PAGE BLANK (USF 1.0)**